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THE MAGAZINE OF METAL COMPONENT DESIGN AND PRODUCTION

NOVEMBER 1983

Precision Metal

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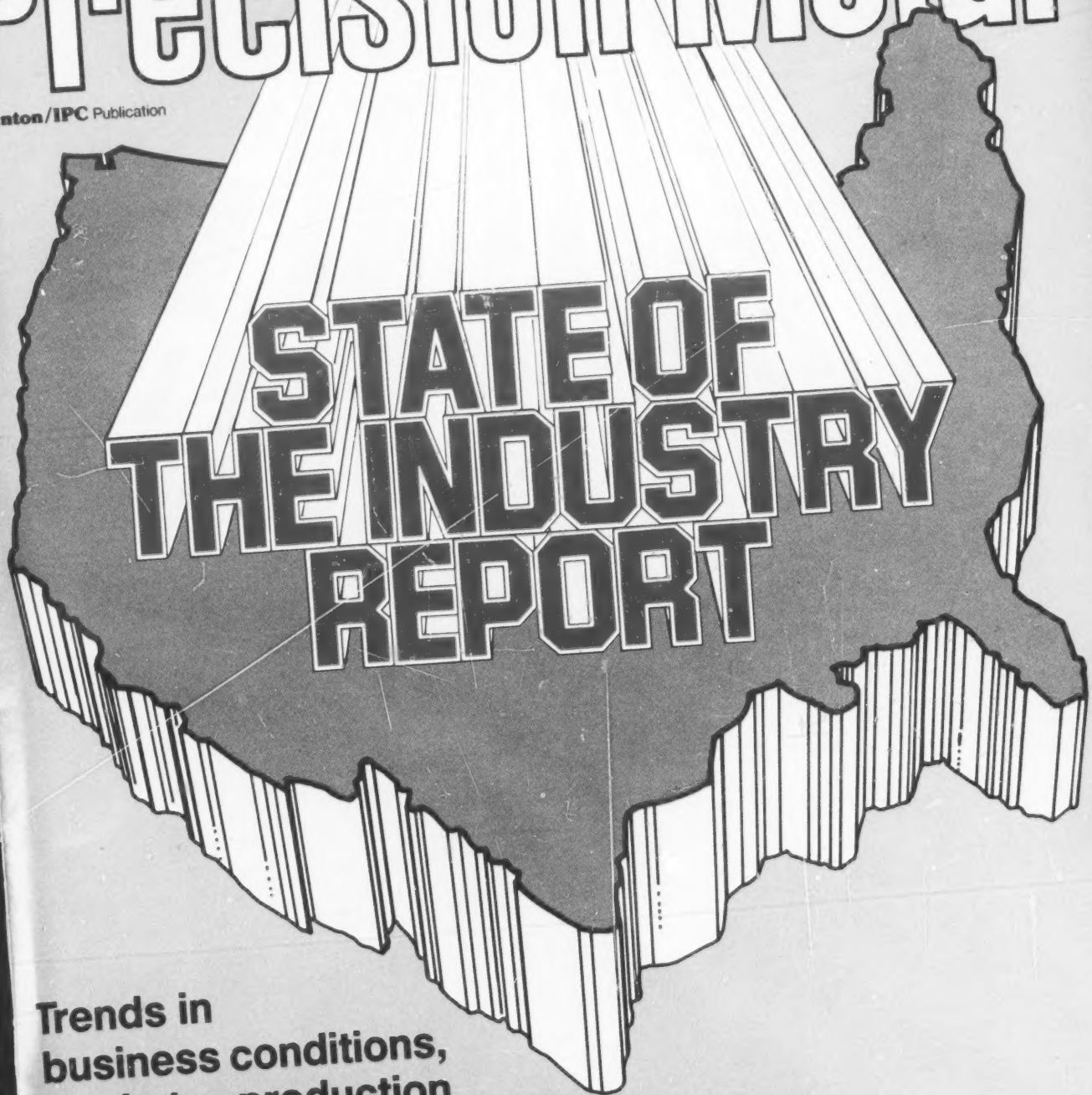

STATE OF THE INDUSTRY REPORT

Trends in business conditions, markets, production and capital expansion for the precision metal industries

Forging Industry Association marks 70th anniversary

November 1983
Volume 41
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Precision Metal

THE MAGAZINE OF METAL COMPONENT DESIGN AND PRODUCTION

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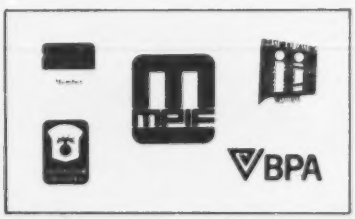

ABOUT THE COVER:

This year's State-of-the-Industry Report provides valuable information for the suppliers to and producers of precision metal components, as well as the end users. This issue will be a handy reference year-round.

Cover design by Marge Swyt.

STATE OF THE INDUSTRY REPORT

The precision metal industries are optimistic this year. New technologies and markets are providing encouragement for 1984 and beyond.

By MICHAEL SHEEHAN and PATTI CUNHOCHWARTH
associate editors

The present state of the domestic precision metal industries is one of retrenchment. The receding economic slump has taken its toll. But those companies who have survived the recession should be getting ready for new growth.

What can the precision metal industries look for in the way of growth? Predicasts Inc., the Cleveland-based business information and research firm, forecasts a 35.2% increase in GNP between 1981 and 1985 in current dollars. However, this growth rate is actually 9.5% using 1972 dollars, which factor out inflation.

Primary metal products' share of GNP is forecast to increase 31.9% in the four-year period between 1981 and 1985 using current dollars, but only 1.4% in 1972 dollars. Likewise, fabricated metal products' share is anticipated to rise 35.8% in current dollars and 0.5% in 1972 dollars.

Two important markets for precision metal components, automotive and housing, offer mixed indicators. United States factory sales of autos are forecasted to increase just 14.1% between 1981 and 1985, while U.S. truck and bus factory sales are expected to increase 41.1% from 1981 to 1985. Housing starts, including mobile homes, are estimated to reach 2,070,000 units in 1985, a 56.2% increase over 1981. New construction expenditures in the private sector are expected to climb 38.7% from 1981 to 1985 in current dollars or 17.6% in 1977 dollars.

According to Predicasts, specific industries expected to exhibit good growth include miscellaneous electrical supplies, electronic components, household appliances, consumer instrument products, miscellaneous consumer goods, equipment instruments and parts, and major electrical equipment and parts.

Industries expected to lag in growth include aircraft and parts, steel mill products, hardware plumbing, structural metal, and automobiles and parts.

Current R & D

The adoption and diffusion of technological innovations such as microprocessor-based technologies will accelerate demand for producer durable equipment incorporating these technologies throughout the 1980's and 1990's, anticipates T. Kevin Swift, Predicasts' chief economist and director, research services.

Technological innovation is the driving force behind economic progress, and research and development is fundamental to technological innovation. Predicasts estimates that R & D expenditures will reach $110 billion by

GROSS NATIONAL PRODUCT[1]						
Category	Billion current dollars			Billion 1972 dollars		
	1981	1985	%Δ	1981	1985	%Δ
Total GNP	2937.7	3972.0	35.2	1502.5	1645.0	9.5
Primary metal prods[2]	50.81	67.0	31.9	19.82	20.1	1.4
Fabricated metal prods[2]	50.14	68.1	35.8	23.87	24.0	0.5

1. Source: Predicasts, Inc.
2. Industry figures based on value added eliminating double accounting, which results when the finished product of one firm becomes the raw material for another. Value added equals employee compensation, net interest, depreciation, taxes and business profits.

1985. These expenditures will be led by industry, which will pump $58.0 billion dollars into R & D in 1985 alone, followed by the federal government with $47.9 billion, and educational institutions at $2.4 billion.

Materials research at NASA, Lewis Research Center (LeRC), Cleveland, is currently focused on improving performance and durability of materials for critical components of power and propulsion systems.

Today's metals research is directed towards high-temperature nickel-base superalloys for gas turbine blades, vanes, combustors and disks. Metals reinforced with high-strength wires and ceramic fibers are also being developed for their unique combination of strength and high-temperature resistance.

The Materials Division of LeRC is presently conducting work on solidification process control. These programs encompass single-crystal turbine blades, powder metallurgy components and melt-spun flake or ribbon technology (also known as rapid solidification processing). In their paper titled "Solidification Process Control for Advanced Superalloys," Hugh Gray and Robert Dreshfield explain how these programs span the solidification rate spectrum and result in net-shape macrocasting or extremely small microcastings which then are consolidated into usable structural components.

Several recent NASA Materials for Advanced Turbine Engines (MATE) programs have demonstrated input material weight savings of approximately one-half and cost savings of approximately one-third relative to conventional cast ingot processing. In addition to material and cost savings, P/M processing offers significant increases in strength and resistance to fatigue failure.

Metallic and thermal barrier coatings have also been developed to better enable materials to operate at higher temperatures and stresses by thermally insulating the substrate. "The key technology required to advance this concept appears to be the compatibility of the ceramic coating and an intermediate metallic bond coat which might be compared to a high temperature glue used to hold the ceramic to the substrate," explains Gray.

Several recent NASA Materials for Advanced Turbine Engines (MATE) programs have demonstrated input material weight savings of approximately one-half and cost savings of approximately one-third relative to conventional cast ingot processing.

Gorham International Inc., Gorham, ME, has been conducting research on containerless HIPing. New processing techniques such as HIP have opened the door for many P/M products to penetrate markets now held by cast and wrought technologies, according to Dr. Andrew Nyce, president of Gorham.

Nyce feels that HIPing of materials represents a multibillion dollar market, with a real compound growth rate of 20-25% annually. Within the next several years, relates Nyce, containerless HIPing of P/M parts could contribute to substantial growth in hot isostatic pressing.

Containerless HIPing is the process whereby metal powder is first pressed and then sintered until all surface-connected porosity is closed. The preform is then HIPed to full density.

Research in basic metal industries has decreased in recent years at Battelle Columbus Laboratories, Columbus, OH. According to Richard Tenaglia, manager of melting and casting, Battelle is not currently working on anything new in investment or die casting, although it recently finished work on direct injection for zinc die casting under the sponsorship of the International Lead and Zinc Research Organization. Tenaglia explains that activities in melting and casting are pretty much centered on the lost-foam process. "The process could represent competition for other casting methods. Surface finish is not very good but it does exhibit good dimensional control," adds Tenaglia.

Battelle has also been heavily involved in forging research and development. According to Taylan Altan, senior research leader, engineering and manufacturing technology department, current R & D is being conducted on close tolerance forging process technology. The project started in December 1980 and scheduled for completion in December, 1983, is sponsored by a group consisting of 41 companies: 18 from North America, 8 from Europe, 14 from Japan and one from Australia. The main objectives of this project are to develop the necessary technical background to enable sponsoring companies to use or improve close tolerance forging techniques and to present this information in a way that companies can quickly implement research results.

Other recent forging-related studies conducted by Battelle include:

- Forging of Tubular Components
- Forging Technology (capabilities and experience)
- Materials Characterization
- CAD/CAM for Precision Forging Special Bevel Gears
- CAD of Forging Operations for Round Parts
- Application of the Finite Element Method to Metal Forming
- Shear Bands in Forging Titanium Alloys
- A Computerized System for Shell Forging
- CAD/CAM for Cold Forming Spur and Helical Gears
- Computing Facilities and Applications to CAD/CAM

Applied technology

Research and development, whether conducted in government and private laboratories, or by industrial concerns, results in commercial application of technology. Robotics is one area of technology that is influencing all areas of metalworking. Automation is looked on as a means of increasing productivity without changing the basic production equipment and can range from one-function dedicated mechanical devices to six-axes robots with continuous path capability. Robots are ideal for repetitive, monotonous jobs and can function in hostile environments. (For more information see "Managing the automation revolution," PM June '83).

"Never before in U.S. manufacturing history has there been such an opportunity to capitalize on technological advancement as a retrofit to existing manufacturing processes and machines," says Walter Weisel, president of Prab Robots Inc., Kalamazoo, MI. "We are in a unique position to make existing plant and equipment cost-effective and competitive in domestic and foreign markets."

According to "Industrial Robots—A Summary and Forecast," published by Tech Tran Corp., Chicago, annual robot sales in the U.S. should rise from 1,700 units in 1982 to about 38,000 per year in 1992. This represents an increase in the total installed base of about 7000 units to approximately 134,000 in 1992. At this level of sales, robots will be used in 5-10% of all suitable manufacturing applications.

RESEARCH & DEVELOPMENT[1]			
	Billion current dollars		
	1981	1985	%Δ
By Source			
Federal gov't	32.9	47.9	45.6
Industry	34.4	58.0	68.6
Educational Inst.	1.5	2.4	60.0
Other	1.0	1.7	70.0
Total R&D	**69.80**	**110.0**	**57.6**

1. Source: Predicasts, Inc.

TRANSPORTATION & HOUSING[1] (000 units)			
	1981	1985	%Δ
Automobile factory sales	6225.0	7100	14.1
Truck & buses factory sales	1701.0	2400	41.1
Housing starts incl. mobile	1325.1	2070	56.2
Mobile home shipments	240.9	350	45.3
One-family starts	705.4	1080	53.1
Multi-family starts	378.8	640	69.0

1. Source: Predicasts, Inc.

Not only is the production process changing, engineering and management systems are changing as well. According to Lionel Chicoine, vice president, purchasing and supply for the Ford Motor Co., engineering and manufacturing process information will be exchanged throughout conception, prototype and production design via computer graphics by the late 1980's. Video conferencing and telecommunications will be commonplace and programs will be designed to electronically transmit information.

"The move beyond CAD/CAM to computer integrated manufacturing (CIM) must be the real goal of American industry"

James Lardner, vice president, manufacturing development for Deere and Co., Moline, IL, sees integration as another way manufacturing is changing. "The move beyond CAD/CAM to computer integrated manufacturing (CIM) must be the real goal of American industry," states Lardner, "It is this CAD/CAM transition that the key to regaining our manufacturing competitiveness lies." But Lardner warns that before rushing into major programs to achieve CIM, the total manufacturing problem needs to be simplified and unnecessary complexity eliminated. (For more information on CAD/CAM, see "CAD/CAM—The key to higher productivity," PM February '83.)

Clayton Williams, manufacturing superintendent for Pontiac Motor Div., Pontiac, MI, agrees with this, but adds that a major challenge facing metal component producers, if not all manufacturers, is identifying all the variables within the manufacturing process and adding controls to those variables.

Statistical process control (SPC) is a management tool for controlling variables and improving productivity. SPC has been dragged out of the closet, dusted off, and brought to the forefront of management attention. Led by a handful of large manufacturing companies, American industry is slowly integrating this concept into its production process. OEM's are currently driving to install SPC programs within their own organizations and the push has begun for OEM suppliers to utilize SPC, and will continue into the future. (For an in-depth discussion of SPC, see "Gear up for production with SPC," PM, May '83.)

Tooling materials is another area where there has been important developments and innovations for the metalworking industries. This is due to the drive to modify conventional tools for

increased productivity, explains Dr. Roger Wright, associate professor, materials engineering, Rensselaer Polytechnic Institute, Troy, NY.

One company that has conducted extensive R & D in new materials for cutting tools is General Electric. Two products in particular have been developed by the Specialty Materials Department of General Electric Co., Worthington, OH, and are said to increase productivity and reduce costs. One is a cubic boron nitride compact that was originally developed for machining superalloys; but, according to G.E., is practical for machining all ferrous materials with a Rockwell C hardness of 45 and above. Consequently, these compacts can handle jobs that once could only be accomplished through grinding. According to G.E., the average productivity improvement of machining over grinding is about four-fold.

According to hardcoating equipment manufacturers, surface alloying can result in a two- to ten-fold improvement in tool life, depending on the application.

The other material G.E. has introduced is a polycrystalline diamond blank for abrasive nonmetallics and nonferrous metals. Polycrystalline diamonds, as randomly oriented crystals, are tightly bonded to each other, resulting in the near elimination of gross failure, reports G.E. Wear is accomplished by a slow, even micro-fracturing of individual diamond crystals, which also acts as a self-sharpening process. Single-crystal natural diamonds, in contrast, have a tendency to chip unpredictably under impact.

Polycrystalline diamond tools were examined in a study conducted by G.E.'s Specialty Materials Department's technical service centers in Worthington, and Dreieich-Sprendlingen, West Germany. The polycrystalline diamond tools were found to machine cast hypereutectic Si-Al alloys at cutting speeds three times that of tungsten carbide with tool life, at the higher cutting speed, approximately three times that of the tungsten carbide cutting tool.

Another area that holds much potential for metalworkers is the hardcoating of tools, both cutting and forming.

Hardcoating techniques have been around for a long time and include case hardening, cyaniding and nitriding. An advanced form of surface hardening that has been in use for a few years is precision hardcoating.

Mechanical, chemical and physical vapor deposition (MVD, CVD and PVD) are three methods of providing an alloy hardcoat through a chemical-metallurgical bond. MVD produces an amorphous structure while CVD and PVD both result in a crystalline structure. These techniques extend tool life by reducing the action of friction and fusion.

Chemical compounds used in CVD and PVD include titanium carbide for abrasive wear and titanium nitride for galling and fusion resistance. MVD utilizes tungsten carbide, titanium carbide, molybdenum, nickel, chrome and nickel borides and diborides as surfacing agents.

CVD and PVD are performed on a batch basis, with PVD the preferred process for coating steel tools with extremely close dimensional tolerances. PVD is performed at temperatures low enough that hardening and tempering do not have to be repeated after the hardcoating process is completed. Dimensional tolerances can be held as close as ± 0.0001 in. MVD is portable and hardcoating can be applied on-site without dismantling the tooling or equipment.

According to hardcoating equipment manufacturers, surface alloying can result in a two- to ten-fold improvement in tool life, depending on the application. Hardcoating costs are proportional to the size of the tool, and can vary from 5 to 50% of the tool's original cost. Hardcoating applications include cutting tools, punches, dies, forming tools, screw machine tools, hot metal dies and wear components.

Performance is a function of how the uncoated tool will perform in a given application and the type of substrate utilized. One Detroit area forger who hardcoats tooling for selected applications says it is not for every job. In his case, hardcoating is not used in extremely hostile environments where the incremental increase in tool life does not justify the increased cost.

Design and production

Taking a cue from the successful Japanese supplier/customer relationship, American manufacturers are in turn, reevaluating their relationship with suppliers and are redefining the role of the supplier in industry. New demands are being made on the supplier.

Procurement practices of OEM's that were intended to foster competition between their suppliers are outdated and counterproductive, according to Ford's Chicoine.

Procurement practices of OEM's that were intended to foster competition between their suppliers are outdated and counterproductive, according to Ford's Chicoine.

"Single sourcing will become typical for most individual parts, and single sourcing habits lasting for the life of those parts will be the accepted way of doing business in the future," states Chicoine. "Selection of suppliers for each part and mutual category will be determined by competitiveness and 'best in class' quality," he maintains. "Best in class" includes cost, productivity, engineering support and delivery.

Just-in-time delivery systems and SPC are two other concepts which will be familiar practices for everyone, predicts Chicoine. "By the 1990's, the domestic auto manufacturers will have at least doubled inventory turn rates," he maintains.

"We can no longer look at a supplier as merely a manufacturer of parts to our design requirements," Chicoine concludes. "The supplier role must,

NEW CONSTRUCTION EXPENDITURES[1]						
	Billion current dollars			Billion dollars at 1977 prices		
	1981	1985	%Δ	1981	1985	%Δ
Private	186.07	258.0	38.7	122.45	144.0	17.6
Public	53.35	63.5	19.0	35.14	37.0	5.3

1. Source: Predicasts, Inc.

and will, expand into the total design process."

Deere's Lardner takes that concept a step further. "Productivity begins with the design function," he explains. "Manufacturing which begins with product design and ends with support and maintenance in the field is a monolithic, indivisible function. Though incredibly complex in its fine detail, all of its components are so intricately connected that no part can be successfully considered in isolation from all other parts. This definition of manufacturing clearly indicates that the design function should be our first concern. It is the beginning of all manufacturing activity. It is also, in my judgement, the single most important problem we have to deal with," asserts Lardner.

Because cost is such a critical factor in the determination of the ultimate balance of product attributes, Lardner thinks it is important to mention producibility as another product characteristic which is essential to controlling manufacturing costs. This is the quality that measures the degree of compatibility between the design of the product and capacity, capability and overall competence of the facility in which the product is made.

The relatively high cost of U.S.-made products and the relatively poor quality image that these products have has been identified as the chief reason for the declining competitiveness of U.S. manufacturers, believes Lardner. Though most of the responsibility for this situation has fallen on manufacturing managers, product designers have been significant contributors to the problem, he says. "If the United States is to retain its position in global markets, designers must make a major contribution to improvements in product cost and quality."

"85-90% of the cost of a product is fixed in the design. Quality must be designed into the product; it cannot be manufactured in. A bad design usually cannot be fixed economically. Today you only get one shot at the customer, and if you miss you fail. It is not enough to ask the factory 'can you make this?' if you want a cost effective design. The right question is 'how well does this design fit with what this factory does well?" says Lardner.

Help from producers

Design engineers do not face productivity problems alone. Metal component producers are in a position to help the engineer design the lowest cost component.

"We can no longer look at a supplier as merely a manufacturer of parts to our design requirements," Chicoine concludes. "The supplier role must, and will, expand into the total design process."

How can the precision metal producer help? O. J. Waters, manager, material engineering for John Deere Horicon Works, Horicon, WI, a large user of die castings, extrusions, forgings, P/M parts and stampings, states that they look for specific characteristics in a custom producer. These characteristics include reliability of the process, competitive pricing, cooperation, a proven track record and quality consciousness.

According to Waters, factors that influence the choice of fabricating process include: total part cost; strength, impact and surface finish requirements; ease of fabrication; ability to make the part in-house; and durability.

In a survey conducted by the Metal Powder Industry Federation, design engineers listed the characteristics that they look for when determining the fabrication method of a particular part. These characteristics, from most important to least, are cost savings, good tolerances, strength, reliability, design complexity, and net shape.

"The high cost of tools also impedes the selection of a process," adds Waters. "The willingness of a producer to try temporary tooling is a first step towards process acceptance." Waters finds that prototypes are difficult to obtain in processes that require extensive tooling, such as forging, die casting, stamping and P/M. "Low cost tooling promotes the process," he contends.

Other suggestions offered by Waters to help custom producers improve their position with metal component users include: visiting potential customers frequently to discuss new design projects, offering to work with special materials if adequately justified, pointing out process variables which can adversely affect part properties, and using and promoting SPC.

The state of the precision metal industries is one of transition and streamlining. "But industry is lagging in making the transition to new technology," claims Professor Wright. "The problem with American manufacturing is that small companies and middle managers are reluctant to make changes."

"Many companies and industries have just become too complacent," charges a senior industrial design specialist for Xerox's Office Products Division, Dallas. "The Japanese worker is not necessarily any better than the American worker. We've had our heads buried in the sand for the last 20 years thinking that we were the best in the world. Others saw this, are taking advantage of it, and now we're scrambling.

"When industries cry about loss of business," states Xerox's design specialist, "I want to say, look at yourselves. Have you really gone out and tried to find out what designers want and need in their product and did you really try to find ways to meet those needs? Or did you just sit back and say, take what we give you."

DIE CASTING

PM's die casting survey covered custom (49%), captive (33%) and combination (18%) shops ranging in size from one to 970 employees and 1982 shipments of 3,000 to 130,000,000 lb.

The survey indicates that the automotive industry is still the largest consumer of die castings, followed by electronics and electrical products, and construction/building products.

"Automotive sales are a good barometer of the die casting industry," says W. Scott Brown, president, ITT Lester Industries, Bedford Heights, OH. "If there is a future for the domestic automotive industry, then there is a future for aluminum die casting. I'd venture to say 80% of all aluminum die castings go into automotive applications." With the surge in domestic automotive sales in 1983, up 23.3% in the first eight months compared to the same period in 1982, according to industry sources, business should be looking up for aluminum die casters.

"There are many new die cast aluminum auto parts still on the drawing board," continues Brown. "European car makers use far more aluminum in their cars than we do. And because of the drive to improve efficiencies, that is the direction we are headed in as well."

For die casters to expand their market positions, they need to redefine their product, according to Dale Nevison, vice president, field operations for the Zinc Institute Inc. "Die casters are no longer strictly in the casting business, but rather in engineered products," he exclaims.

"A strong, active, aggressive marketing program is a prerequisite to survival and potential growth for the die caster, and certainly to the industry," says John Rutherford, manager of market development, Aluminum Smelting and Refining Co./Certified Alloys, Maple Heights, OH.

"We're competing with plastics, other die casters, and other fabricating and processing methods," adds Trevor Davis, vice president, sales and marketing, Newton New Haven Co., North Haven, CT. "We need to aggressively seek new markets."

Peter A. R. Findlay, president, American Die Casting Institute (ADCI), stresses the importance of continued research and development together with dissemination of new technology.

Findlay believes that dissemination of technological advances will help the die casting industry improve its worldwide reputation and ensure continued use of die castings in established markets. "Today we see increased R & D communication and a substantial closing of the technology gap which had prevailed between various countries," concludes Findlay.

According to Department of Commerce figures, aluminum and zinc permanent mold and die casting shipments increased the first six months of 1983 over the same period in 1982. Aluminum permanent mold casting shipments rose 5.3% while die casting shipments increased 4.3%.

Zinc die casting shipments increased 9.2% for the January through June 1983 period over the same time in 1982, reports the Department of Commerce.

1983 shipment projections show that the majority of die casters surveyed anticipate improvement in 1983 over 1982. 60% expect shipments of castings in all metals to be up in 1983; 23% project shipments to remain the same as 1982 and 17% foresee shipments to fall.

The ADCI expects die casting sales to rise 12% in 1983 to $5.5 billion. Findlay noted a mood change from

continued on page 33

PLANT SIZE BREAKDOWN	
Hourly employees /plant	
Average	67
Median	20
Low	1
High	970
1982 Shipments/plant	
Average	6,669,671 lb
Low	3,000 lb
High	130,000,000 lb

1983 DIE CASTING SHIPMENTS BY METAL (compared to 1982)

Metal	% of Respondents	% Up	% Down	% Same
Zinc	71.0	67.0	11.0	22.0
Aluminum	58.0	59.0	18.0	23.0
Magnesium	2.5	—	100.0	—
ZA alloy	2.5	100.0	—	—
Lead	5.5	—	50.0	50.0
Total	**100.0**	**60.0**	**17.0**	**23.0**

CASTING SHIPMENTS (in 000 lb)

Metal	Jan-June 1983	Jan-June 1982	% Δ
Copper & copper-base alloy			
Permanent mold	9,225	10,184	−9.4
Die cast	1,045	1,280	−18.4
Aluminum & aluminum-base alloys			
Permanent mold	130,754	124,129	+5.3
Die cast	466,223	446,867	+4.3
Zinc & zinc-base alloys			
Die cast	147,301	134,890	+9.2
Magnesium & magnesium-base alloys			
Permanent mold & die cast	3,803	5,281	−28.0

Source: U.S. Dept. of Commerce, Bureau of the Census

HOT CHAMBER MACHINES						
	Now installed		Plan to buy by end of 1984		Plan to rebuild by end of 1984	
Size (tons)	% of total plants	Avg/plant	% of total plants	Avg/plant	% of total plants	Avg/plant
Under 100	35.0	5.0	7.5	1.3	12.5	4.0
100-250	50.0	2.9	2.5	1.0	12.5	1.8
251-400	35.0	3.1	—	—	5.0	2.0
401-600	20.0	4.0	—	—	—	—
601-850	10.0	4.0	—	—	—	—
Over 851	—	—	—	—	—	—
Total	**75.0**	**7.4**	**12.0**	**1.6**	**22.5**	**3.7**

COLD CHAMBER MACHINES						
	Now installed		Plan to buy by end of 1984		Plan to rebuild by end of 1984	
Size (tons)	% of total plants	Avg/plant	% of total plants	Avg/plant	% of total plants	Avg/plants
Under 250	15.0	2.8	5.0	1.0	2.5	1.0
251-550	42.5	2.8	2.5	1.0	2.5	1.0
551-700	30.0	5.0	2.5	1.0	5.0	1.5
701-850	7.5	14.7	—	—	2.5	5.0
851-1,000	10.0	15.5	—	—	2.5	8.0
Over 1,000	N/A	N/A	—	—	—	—
Total	**55.0**	**10.5**	**10.0**	**1.0**	**10.0**	**4.5**

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"grave concern last year to cautious optimism" at ADCI's 55th Annual Meeting held in September. Looking ahead, ADCI expects zinc die casting sales to increase somewhat and aluminum sales to rise significantly in 1984.

Survey respondents reported that 17.1% of their 1982 business constituted first time customers and/or jobs. Of this percentage, 26.2% switched over from other fabricating methods and materials such as sand casting, investment casting and machining. This results in a 4.5% conversion rate to die castings achieved by the responding plants.

89% of our respondents' equipment is commercially built, with 69.5% of the equipment rated in good condition, 26% fair and the remaining 4.5% in poor condition. Die cast machine age distribution is fairly normal with an average machine age of 13 years. 31% of our respondents' tooling was made in-house and the balance produced in outside die shops during 1982.

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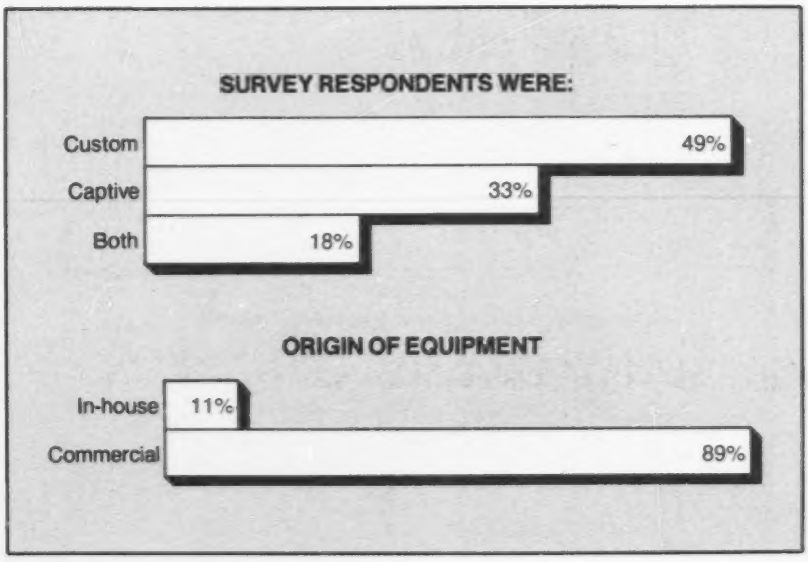

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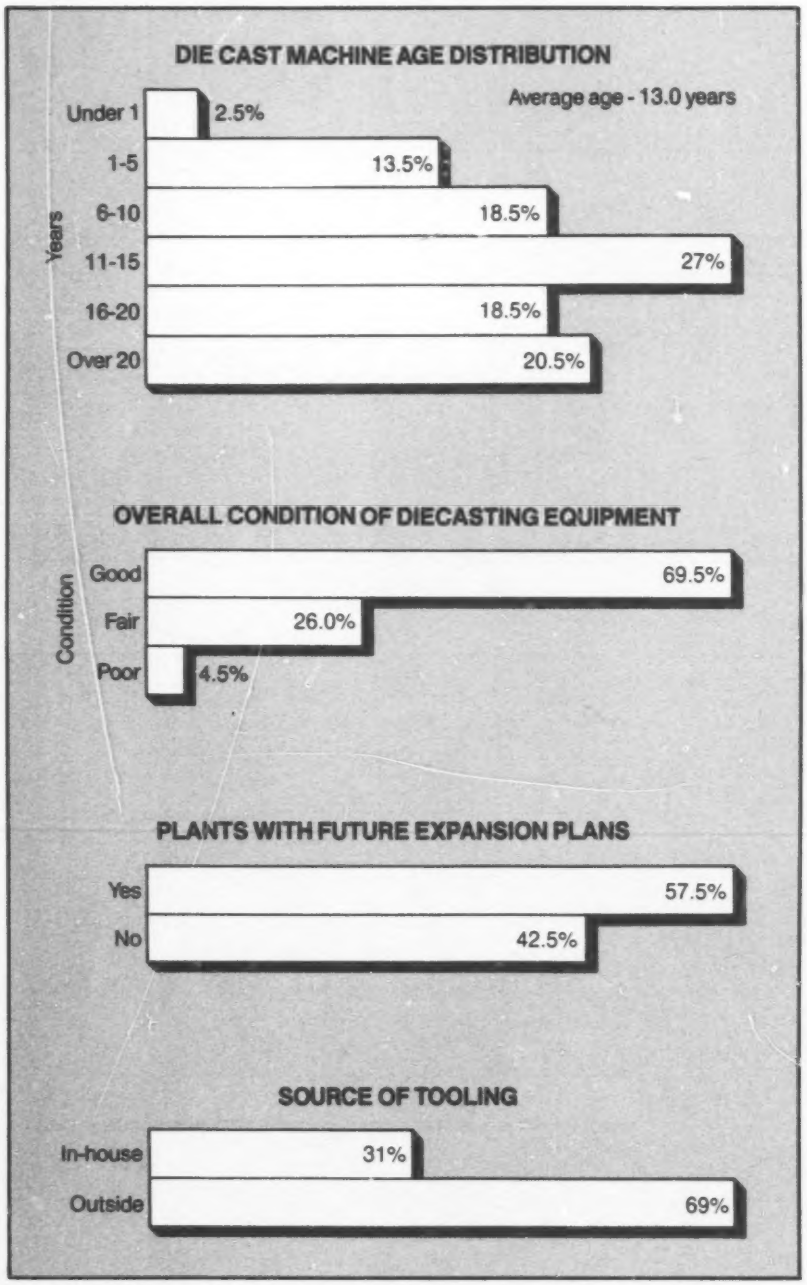
Survey results reveal that 57.5% of our respondents have unspecified future expansion plans. 12% of all respondents plan to purchase hot chamber machines by the end of 1984 at a rate of 1.6 per facility, which would increase the total number of installed hot chamber machines by 3.6%. 22.5% of the respondents plan to rebuild their hot chamber machines at a rate of 3.7 per plant, for a remodernization rate of 14.9%.



Our survey also shows that 10% of the die casters plan on purchasing cold chamber machines by the end of 1984 at a rate of one/plant, for an increase in total installed cold chamber machines of 1.7%. The same percentage of respondents (10%) plan on rebuilding their cold chamber machines, but at a much higher rate of 4.5 machines/plant, for a remodernization rate of 7.8%.

Technological advances that are available to die casters include new fuel and cost-saving furnaces, improved mixing burners, heat recuperators, and preheaters. "Within the next five to 10 years, we will see the majority of die casters completely change their present melting system," states Robert Allen, president of the Society of Die Casting Engineers.

The new generation melting furnaces have been improved through built-in heat exchangers, recuperators for preheating and improved insulation resulting in as much as a 40% fuel cost savings, explains one furnace manufacturer. High-velocity burners are available for conventional reverberatory furnaces that are capable of melting aluminum alloy with as few as 1200 BTU's per lb.

A major development in zinc die casting is the direct injection system developed at Battelle Columbus Laboratories under the sponsorship of the International Lead Zinc Research Organization Inc. (ILZRO). According to Dr. Frank Goodwin, manager of metallurgy and program development at ILZRO, direct injection can be applied to any hot chamber die casting machine with no major limitations.

The system works by using heated "mini nozzles" that move zinc directly from the melt into the die cavity. There is little waste because only the nipples between the nozzle and the cavity solidify. Direct injection should eliminate remelt costs for runners and other unusable parts of the casting, representing about a 2% metal savings by weight, claims ILZRO.

EXTRUSION

PM's extrusion survey covered facilities ranging in size from two to 1200 employees and 1982 shipments of 5000 to 100,000,000 lb. Custom (50%), captive (18%) and combination (32%) shops were included.

PM's survey indicates that the construction/building industry is the largest consumer of extrusions, followed by the automotive and electronics/electrical industries. Other important markets for extrusions noted by the Aluminum Association include: recreational products; home repairs (windows and doors); home appliances; computers; copy machines and word processors; solar collectors; machinery and equipment; and highway products such as medians, lighting and guard rails.

The survey respondents revealed that 18.4% of their 1982 business included first time customers and/or jobs. Of this new business, 30.9% had previously been produced by other methods, such as casting, P/M or fabricated sheet metal, resulting in a 5.7% conversion rate to extrusions by our responding plants.

Among the aluminum extruders surveyed, 88% feel business in 1983 will show an improvement over 1982. Combining all metal categories, 78.8% of our respondents anticipate an improvement in 1983.

"Business is picking up," says Dan Milligan, general manager-extrusions, Kaiser Aluminum and Chemical Co., Oakland, CA. "We expect to see a 10-15% gain in 1983 over 1982. We are also hopeful for 1984, but a large part of that depends on the interest rates."

Bill Hochstetler, sales manager, Midwest Aluminum, Kalamazoo, MI, says: "Our sales level is running ahead of last year and we forecast that at year end, we'll be 15% ahead of 1982."

The Aluminum Association reports an 8.0% increase in May and 5.1% in June, 1983 over the same period in 1982 for shipments of aluminum extrusions. Bookings increased 7.1% in June and 37.1% in July of this year over the same months in 1982.

PM's respondents report that 15.5% of their equipment is built in-house while 84.5% is built commercially. The average age of our respondents' extrusion presses is 16.3 years with a skewed distribution to the high end. On the average, 74% of the in-plant equipment is rated in good condition, while 24.5% is considered fair and 1.5% is judged to be in poor condition. 42.5% of the extrusion tooling is reportedly made in-house while the remaining 57.5% is made in outside die shops.

48% of our respondents indicate that they have some unspecified plans for expansion or capital improvement in the future. But only 3.5% of our respondents plan to purchase a new press by the end of 1984. This expan-

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1983 EXTRUSION SHIPMENTS BY METAL (compared to 1982)

Metal	% of Respondents	% Up	% Down	% Same
Aluminum	70.8	88.0	—	12.0
Brass	12.5	100.0	—	—
Magnesium	4.2	100.0	—	—
Copper	20.8	40.0	—	60.0
Other	29.2	92.0	4.0	4.0
Total	**100.0**	**78.8**	**3.0**	**18.2**

EXTRUSION PRESSES SIZE DISTRIBUTION AND CAPITAL EXPANSION

Size (tons)	Now installed		Plans to buy		Plans to rebuild	
	% of Plants	Avg/plant	% of Plants	Avg/plant	% Plants	Avg/plant
Under 1000	28.5	2.0	—	—	—	—
1000/1500	25.0	1.7	—	—	—	—
1501/2000	32.0	1.4	3.5	1.0	—	—
2001/3000	35.5	1.7	—	—	3.5	1.0
3001/5000	26.5	1.4	—	—	7.0	1.0
Over 5000	10.5	1.0	—	—	—	—
Total	**100.0**	**2.6**	**3.5**	**1.0**	**10.5**	**1.0**

PLANT SIZE BREAKDOWN

Hourly employees/plant	
Average	105
Median	40
Low	2
High	1200
1982 Shipments/plant	
Average	14,220,000 lb
Low	5,000 lb
High	100,000,000 lb

1982 NET SHIPMENTS BY MAJOR MARKET (in millions of lb)

Market	Extruded shapes	Extruded pipe & tube
Building & construction	1106	19
Transportation	284	14
Consumer durables	80	20
Electrical	72	49
Machinery & equipment	72	13
Containers & packaging	—	—
Other	81	3
Statistical adjustment	—	48
Domestic, total	1695	70
Exports	9	12
Total	**1704**	**82**

Source: Aluminum Association

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sion rate of one/plant would increase the number of installed presses by 1.4%.

Rebuilding activity is reported to be higher through 1984 than new purchases. 10.7% of our respondents plan to rebuild at a rate of one press/plant for a renovation rate of 4.2%.

New developments in extrusion technology center mainly on improving yields and reducing manpower, plus achieving efficiencies in log heating.

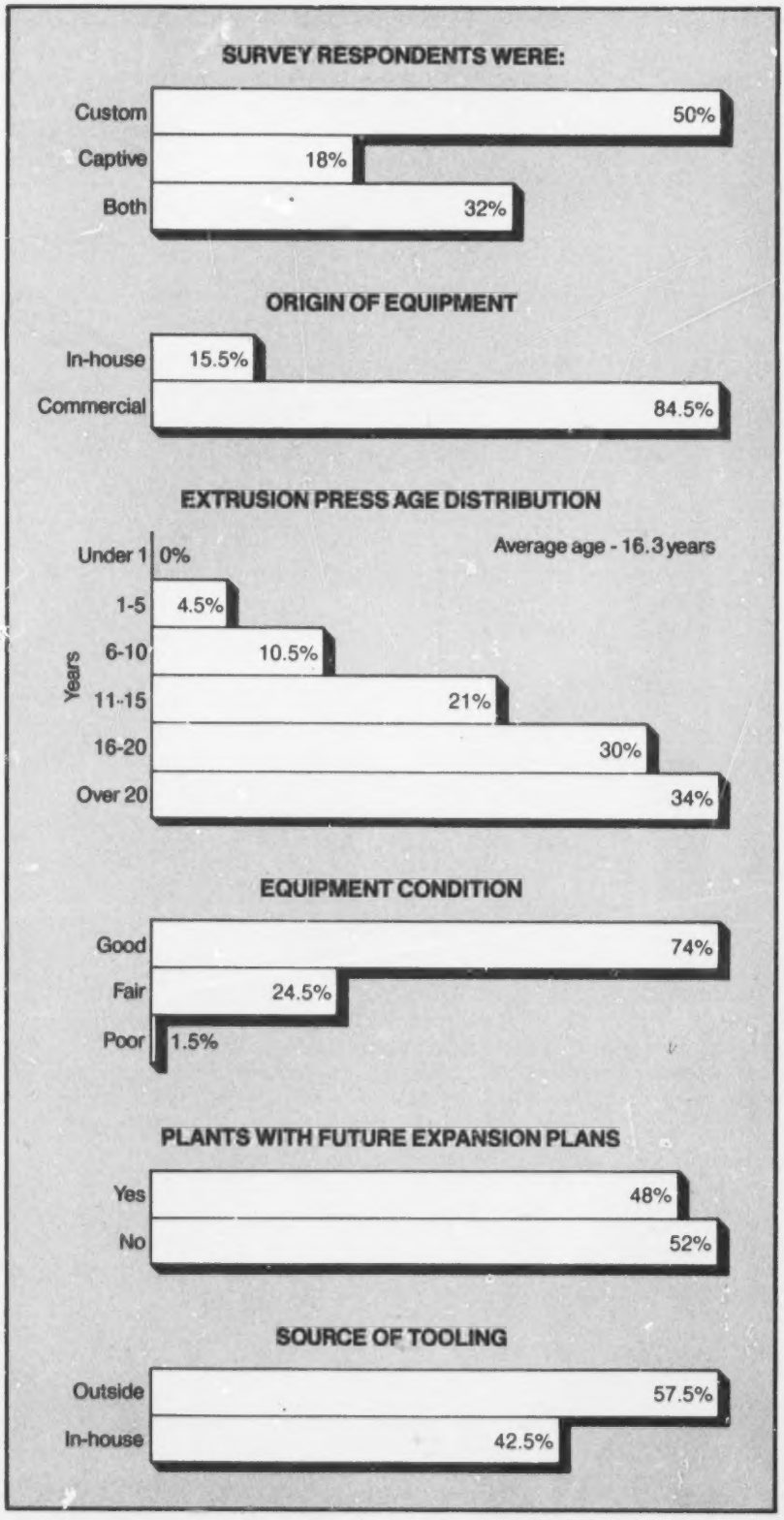
Hochstetler of Midwest Aluminum claims that the only new press advancements that they are considering involve automation. "We are in the process now of automating. Our goal is to get more productivity out of existing presses, not to add more presses," he explains.

Equipment that contributes to increased productivity and better yields includes extrusion pullers and log shears. According to equipment manufacturers, both types of equipment have been utilized in Europe for some time, and are only just now gaining acceptance in the U.S.

Others in the process of capital expansion include New Jersey Aluminum, New Brunswick, NJ, that recently completed a new cast house at its facility in North Carolina, and General Extrusion of Youngstown, OH, that just completed a new plant in Union City, GA, which will immediately increase capacity 25% and is scheduled to eventually double it. Another custom producer foresees renewed efforts to increase value-added and has plans to expand its own machining, finishing, welding and fabricating capabilities.

An advanced application of the extrusion process is the hydrostatic extruder for large scale industrial production. However, according to one hydrostatic extrusion press builder, this technology largely remains a solution looking for a problem.

To help disseminate state-of-the-art technology, the Aluminum Association is sponsoring the "Third International Aluminum Extrusion Technology Seminar" April 24-26, 1984, in Atlanta, GA.



FORGING

PM's forging study covered custom (61%), captive (14.5%) and combination (24.5%) facilities ranging in size from one to 800 employees and 1982 shipments from 20,000 to 201,600,000 lb. Captive-only production is on a definite downward trend. Last year, captive-only production represented 23.2% of the respondents, while 1981 comprised 27.5%. This trend illustrates the move by captive shops to utilize excess capacity by turning to custom work.

Aerospace is the largest consumer of custom impression die forgings, followed by automotive and off-highway equipment respectively, according to official figures compiled by the Forging Industry Association (FIA). The FIA does not compile figures for open die forging sales.

Respondents report that first time customers and/or jobs accounted for 11.6% of their 1982 business. Of this amount, 6.4% switched over from manufacturing methods other than forging. This results in a 0.7% conversion rate to forgings for our respondents.

Surveyed forgers are pessimistic about shipment levels for 1983. Only 25% of closed impression die forgers, 11.9% of open die forgers and 39.7% of other (ring rolling, heading, upsetting and extrusion) expect an improvement in 1983 over 1982.

The FIA reports shipments of custom impression die forgings for the first eight months of 1983 down 26% from 1982, but bookings up 19%for the same period. Custom open die forging shipments for the first eight months of 1983 are 45% below the same period in 1982,while bookings are down 30%.

Robert Read, president of FIA and Teledyne Portland Forge, Portland, IN, states that a big problem for the forging industry today is excess capacity. "It will be some time before capacity limits are tested," he proclaims.

As a consequence of excess capacity, new technology can be stymied. The screw press is an example of this. According to Read, the screw press is more productive than a hammer and does not require the level of skill needed to operate the hammer. Yet, with the present state of the economy, a used hammer can be picked up at a cost substantially less than a screw press, resulting in a higher return on investment.

Not everything is at a dead standstill in the forging industry. Ellwood City Forge Corp., Ellwood City, PA, is spending $8.7 million on a computerized open-die forging shop and another $10 million on a rotary forge shop. Sifco Forge Group and Alcoa Forgings Div., both of Cleveland, have installed new computer-aided design (CAD) forging tool and die systems and rebuilt or added new forging hammers and presses this past year.

The Pioneer Division of Letts Indus-

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PLANT SIZE BREAKDOWN	
Hourly employees/plant	
Average	68
Median	25
Low	1
High	800
1982 Shipments/plant	
Average	9,147,800 lb
Low	20,000 lb
High	201,600,000 lb

SIZE AND SEGMENTS OF THE FORGING INDUSTRY	
Custom impression die	41.4%
Custom open die	15.7%
Custom ring rolling	7.1%
Custom cold forging	4.3%
Captive impression die	8.6%
Catalog impression die	22.9%
Total	**100.0%**

1983 CLOSED IMPRESSION DIE ESTIMATE (compared to 1982)

Metal	% of respondents	% Up	% Down	% Same
Carbon steel	71.1	33.3	33.3	33.3
Common alloy steel	60.5	26.1	47.8	26.1
Stainless steel	31.6	16.6	41.7	41.7
Aluminum	15.8	—	66.7	33.3
Titanium	5.3	—	50.0	50.0
Brass & copper	13.2	40.0	—	60.0
Other nonferrous	5.3	—	—	100.0
High-temperature	7.9	33.3	33.3	33.3
Total	**100.0**	**25.0**	**38.8**	**36.2**

1983 OPEN DIE ESTIMATE (compared to 1982)

Metal	% of respondents	% Up	% Down	% Same
Carbon steel	85.7	8.3	50.0	41.7
Common alloy steel	57.1	12.5	50.0	37.5
Stainless steel	35.7	20.0	60.0	20.0
Aluminum	21.4	—	33.3	66.7
Titanium	21.4	—	33.3	66.7
Brass & copper	28.6	50.0	—	50.0
Other nonferrous	21.4	—	—	100.0
High-temperature	28.6	—	50.0	50.0
Total	**100.0**	**11.9**	**40.5**	**47.6**

1983 FORGING ESTIMATE (Other: including ring rolling, heading upsetting and extrusion) (compared to 1982)

Metal	% of other respondents	% Up	% Down	% Same
Carbon steel	76.0	47.4	15.8	36.8
Common alloy steel	60.0	40.0	20.0	40.0
Stainless steel	28.0	42.8	28.6	28.6
Aluminum	20.0	20.0	20.0	60.0
Titanium	20.0	20.0	20.0	60.0
Brass & copper	28.0	71.4	—	28.6
Other nonferrous	16.0	—	—	100.0
High-temperature	24.0	33.3	16.7	50.0
Total	**100.0**	**39.7**	**16.2**	**44.1**

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tries started production in its brand new facility this past January in Pioneer, OH. The facility, representing an investment of over $4 million, is composed of the latest technology in screw presses, robots and induction heaters. According to Charles Letts, Jr., executive vice president, the facility was started in the depths of the recession, and is now ready to capitalize on the improved economy. Presently, the facility is composed of two forging lines, and a third is scheduled to be added in late 1984.

Other technical developments in the forging industry, according to Read, include: energy conservation through improved insulation, better control of burners and the use of oxygen enrichment; robotics; CAD/CAM; hydraulic retrofit for the steam hammer; and employee safety.

Overall condition of all in-plant forging equipment is rated by our respondents as 71.5% in good condition, 22.5% in fair and 6% in poor condition. 86% of in-plant equipment is commercially built, the balance fabricated in-house. 28.5% of our respondents indicate that they have some unspecified future expansion or capital improvement plans.

Hydraulic presses are utilized in 40.8% of the respondents' plants at a rate of 4.1 presses/plant. The average age of a hydraulic press is 15.8 years. 10.2% of the respondents plan to add hydraulic presses to their facilities by the end of 1984 at a rate of 1.2 presses/plant for a total increase in installed hydraulic presses of 6.1%.

38.8% of the responding plants use mechanical presses at a rate of 6.5

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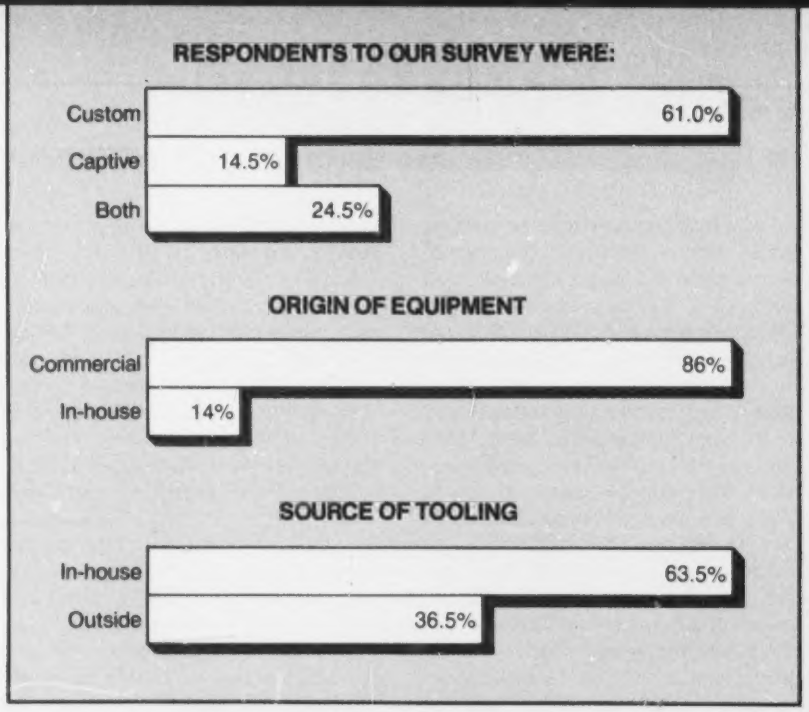

STEAM & AIR HAMMERS

Size (lb)	Now installed		Plan to buy by end of 1984	
	% of all forging plants	Avg/plant	% of total plants	Avg/plant
Less than 1,000	2.0	1.0	—	—
1,001 - 5,000	32.7	4.9	2.0	3.0
5,001 - 10,000	20.4	2.4	2.0	1.0
10,001 - 25,000	4.1	2.0	2.0	1.0
25,001 - 50,000	—	—	—	—
Total	**38.8**	**5.6**	**6.1**	**1.7**

BOARD HAMMERS

Size (lb)	Now installed		Plan to buy by end of 1984	
	% of all forging plants	Avg/plant	% of total plants	Avg/plant
Less than 1,000	10.2	2.2	—	—
1,001 - 5,000	24.5	5.4	—	—
5,001 - 10,000	2.0	1.0	—	—
10,001 - 25,000	—	—	—	—
25,001 - 50,000	—	—	—	—
Total	**24.5**	**6.4**	—	—

FORGING PRESSES

Size (tons)	Now installed				Plan to buy by end of 1984			
	Mechanical		Hydraulic		Mechanical		Hydraulic	
	% of all forging plants	Avg/plant	% of all forging plants	Avg/plant	% of all forging plants	Avg/plant	% of All forging plants	Avg/plant
100-500	18.4	6.0	20.4	5.0	—	—	—	—
501-1,000	18.4	2.0	14.3	2.1	—	—	4.1	1.0
1,001 - 2,000	14.3	2.0	14.3	1.3	4.1	1.0	4.1	1.0
2,001-5,000	12.2	6.0	4.1	2.5	4.1	1.0	2.0	1.0
5,001-10,000	4.1	1.0	6.1	1.0	—	—	—	—
Over 10,000	—	—	—	—	—	—	2.0	1.0
Total	**38.8%**	**6.5**	**40.8%**	**4.1**	**6.1**	**1.3**	**10.2**	**1.2**

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presses/plant with an average age of 14.1 years. 6.1% of the surveyed forgers plan to acquire mechanical presses before the end of 1984 at a rate of 1.3 presses/plant for an increase in installed presses of 3.2%.

Installed steam and air hammers have an average age of 13.6 years and are utilized by 38.8% of our respondents. 6.1% of the responding plants plan to add steam and/or air hammers by the end of 1984 at a rate of 1.7 hammers/plant for an increase in existing hammers of 4.7%.

Board hammers are growing older in our respondents' plants with no plans for replacement. 24.5% of the respondents utilize board hammers at a rate of 6.4 hammers/plant with an average age of 17.4 years.

24.5% of the survey respondents employ upsetters at a rate of 2.2/plant with an average age of 18.4 years. There are no plans to purchase upsetters among those surveyed through 1984.

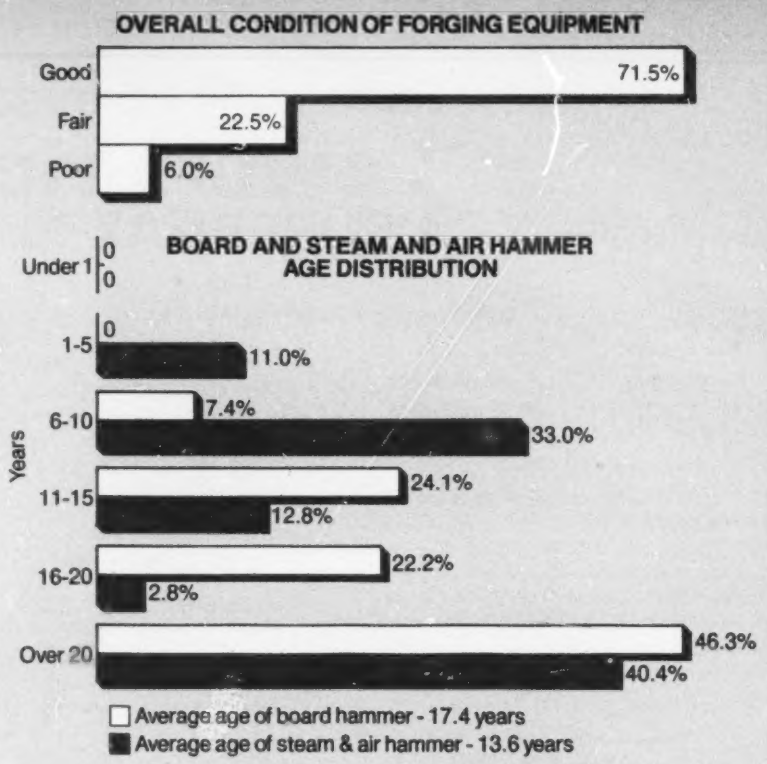
Cold headers are utilized in 12.2% of the respondents' facilities at a rate of 3 headers/plant with an average age of 15.2 years. Again, our respondents state they have no plans to purchase new cold headers through 1984.

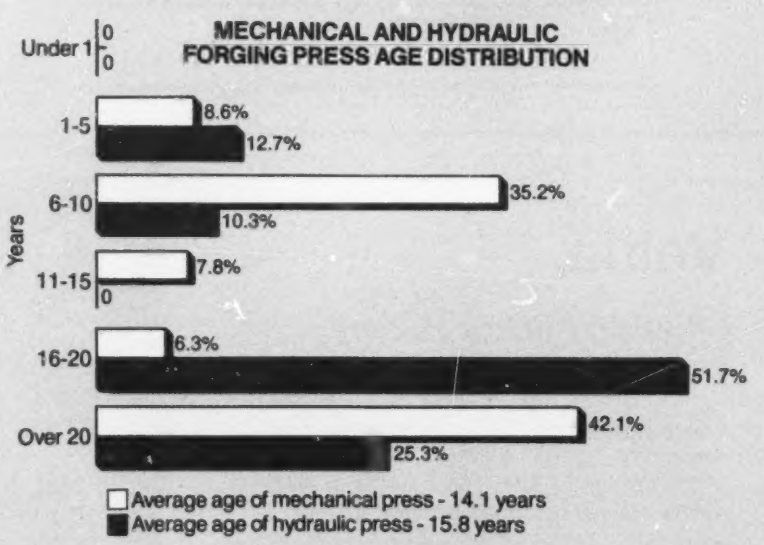
Sources of tooling for our surveyed forgers is predominantly in-house (63.5%), while 36.5% is provided by outside tool and die shops.

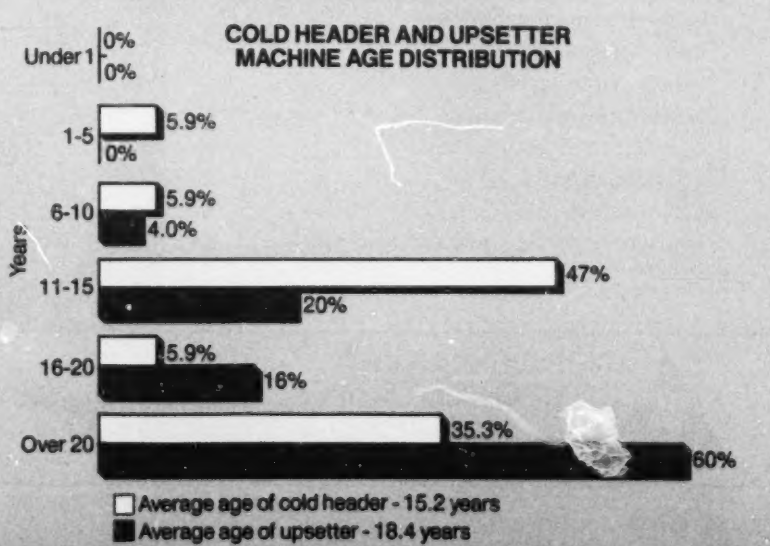
COLD HEADERS AND UPSETTERS (now installed)

Cold headers		
Size (in)	% of total plants	Avg/plant
1/8-1/4	2.0	1.0
1/4-1/2	8.2	1.5
1/2-3/4	8.2	2.0
3/4-1	4.1	1.0
Over 1	2.0	1.0
Total	**12.2**	**3.0**

Upsetters		
Size (in)	% of total plants	Avg/plant
1/2	—	—
1	12.2	1.2
1 1/2	4.1	1.0
2	2.0	1.0
2 1/2	4.1	1.0
3-4	6.1	2.7
5-6	6.1	2.0
Total	**24.5**	**2.2**







INVESTMENT CASTING

The respondents to PM's investment casting survey were largely custom shops (63%), while 16% were captive and 21% combination shops. Surveyed facilities range in size from two to 273 employees and 1982 shipments of 20 to 5,000,000 lb.

Our respondents' outlook for 1983 is one of caution. Although only 25% of the casters in all metal categories feel business will be below 1982 levels, only 35% feal that there will be an improvement. Casters are a bit more pessimistic in the carbon and alloy steel categories. Only 26% of the carbon steel casters and 27% of the alloy steel casters feel 1983 shipments will surpass 1982.

Indications from the Investment Casting Institute are that net sales during the first eight months of 1983 are down 5% over the same period in 1982, but net bookings are up approximately 3% through August, 1983 over the same period in 1982. Bookings are said to have been steadily improving since the first of the year when the downward trend bottomed out.

The traditional markets for investment castings include aerospace, automotive and construction/building products. But Ross Lienhart, senior market analyst for Precision Castparts Corp., Portland, OR, sees the application of investment castings growing as productivity rates continue to climb. "Investment casting already plays a key role in aerospace and I think it also will happen in the industrial sector. Technology is continuing to decrease casting costs, and two factors that are playing important roles are CAD/CAM and robotics," he explains. There is also a definite trend toward larger and lighter castings. "For instance, titanium is replacing 17-4 stainless steel in a variety of applications," adds Lienhart.

The densification of castings through HIPing is another factor that will allow investment castings to ex-

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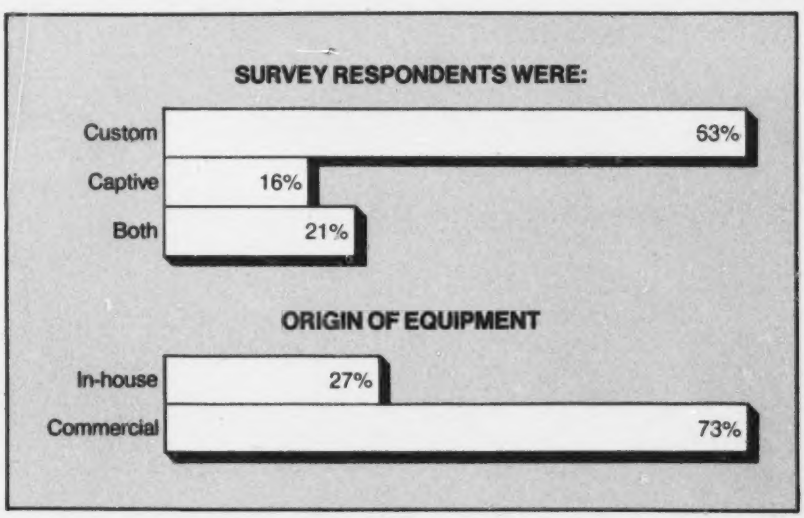
PLANT SIZE BREAKDOWN	
Hourly employees/plant	
Average	68
Median	68
Low	2
High	273
1982 Shipments/plant	
Average	627,135 lb
Low	20 lb
High	5,000,000 lb

1983 INVESTMENT CASTING SHIPMENTS BY METAL (compared to 1982)

Metal	% of respondents	% Up	% Down	% Same
Aluminum	51.0	53.0	14.0	33.0
Copper	39.0	45.0	22.0	33.0
Magnesium	7.5	—	33.0	67.0
Titanium	10.0	25.0	25.0	50.0
Carbon steel	75.5	26.0	39.0	35.0
Alloy steel	90.0	27.0	24.5	48.5
Stainless steel	58.5	33.0	25.0	42.0
Super alloys	39.0	44.0	25.0	31.0
High temp. alloys	41.5	41.0	12.0	47.0
Other	19.5	37.5	25.0	37.5
Total	**100.0**	**35.0**	**25.0**	**40.0**

WAX INJECTION PRESSES

	Now installed		Plan to buy by end of 1984	
Size (tons)	% of total plants	Avg/plant	% of total plants	Avg/plant
5 and under	53.1	4.0	18.8	1.2
6-15	34.4	7.2	—	—
16-35	34.4	5.5	12.5	2.0
36-50	34.4	2.1	3.1	2.0
51-100	9.4	3.3	3.1	1.0
Over 100	—	—	—	—
Total	**100.0**	**7.5**	**37.5**	**1.5**



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pand into other markets. "HIPing densification, being a relatively new manufacturing process, has many promising applications," says John McFadden, development manager at the R & D center of Howmet Turbine Components Corp., Whitehall, MI. These applications include composite part development combining powder metal with a casting; rejuvenation of creep-induced casting defects; and the creation of new hybrid parts by the diffusion bonding of two different parts.

Survey respondents report that 24.2% of their 1982 business involved first time customers and/or jobs. Of this, 22.3% switched over from other fabricating methods, resulting in a 5.4% conversion rate.

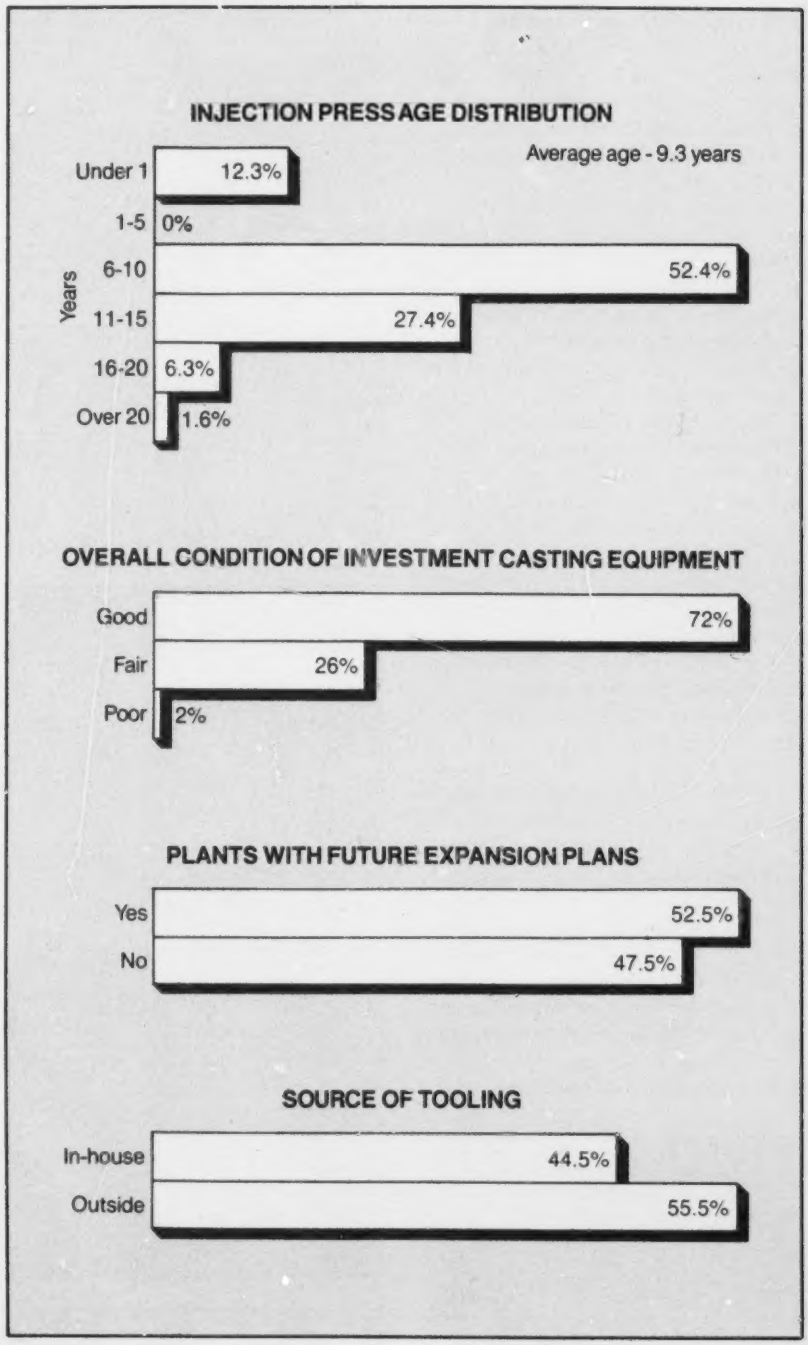
Respondents report that 73% of in-plant equipment is commercially built while 27% is fabricated in-house. On the average, respondents rate 72% of plant equipment in good condition, while 26% is considered fair and 2% is judged to be in poor condition. Wax injection machine age distribution is normally distributed with an average age of 9.3 years, indicating ongoing replacement.

The majority of our respondents (52.5%) indicate that they have some unspecified future expansion or capital improvement plans. 37.5% of the responding plants plan on adding wax injection machines to their facilities at a rate of 1.5 machines/plant, for an increase in existing injection machines of 7.5%.

A full range of wax injection machines, categorized by die size, are utilized by the surveyed investment casters. 23.5% of the facilities have an average of 2.3 injection machines which can handle dies over 30 in. in size. 44.5% of tooling is reported to be made in-house and the remaining 55.5% is said to be commercially built.

WAX INJECTION MACHINES BY DIE SIZE

Die size (in)	% of total plants	Avg/plant
8 and under	58.5	3.2
9-15	52.9	2.0
16-20	41.2	2.6
21-30	35.3	1.2
Over 30	23.5	2.3



POWDER METALLURGY

PM's study of the powder metallurgy industry covered custom (61%), captive (30%) and combination (9%) shops ranging in size from one to 500 employees and 1982 shipments of 100 to 5,400,000 lb.

Respondents report that 17.7% of their 1982 business constituted first time customers and/or jobs. Of this amount, 34% had been previously fabricated by other methods such as machining, forging, casting and stamping. This results in a 6% conversion rate in 1982 to P/M.

Shipment projections show steady, if not improved conditions for 1983. 70% of the iron and steel P/M producers expect improvements for 1983 while 43% of the producers in all metal categories anticipate shipments to improve and 40% are projecting 1983 to remain the same as 1982.

Peter Johnson, director of marketing for the Metal Powder Industries Federation (MPIF) feels business is now starting to improve. According to Johnson, there was a 26% improvement, 72,805 short tons vs. 57,828, in shipments of iron powder for P/M parts in the first six months of 1983 compared to 1982.

The results of PM's survey show that automotive, appliance and furniture/office equipment are the primary markets for our respondents' P/M parts. In addition to these, the MPIF lists power tools and lawn and garden equipment as other important P/M markets.

The MPIF has formulated a three year marketing plan to increase the P/M growth rate from 5% per year to 8-10% by 1986. To accomplish this, MPIF is working to expand current P/M markets and develop new ones, increase awareness of P/M parts and increase P/M's share of the fabricated metal products markets.

Henry Adams, regional sales manager for Dixon Sintaloy, Inc., Stamford, CT, feels that P/M's potential lies in high volume consumer items. "We also feel that the only effective way of getting new business is by working with the customer's or potential customer's engineers. And it helps to be innovative," declares Adams.

Only 13.5% of the respondents'

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PLANT SIZE BREAKDOWN	
Hourly employees/plant	
Average	60
Median	15
Low	1
High	500
1982 Shipments/plant	
Average	819,238 lb
Low	100 lb
High	5,400,000 lb

1983 P/M SHIPMENTS BY METAL (Compared to 1982)

Metal	% of Respondents	% Up	% Down	% Same
Aluminum	19.5	43.0	—	57.0
Brass	30.5	36.0	9.0	55.0
Bronze	36.0	31.0	23.0	46.0
Iron & steel	55.5	70.0	15.0	15.0
Stainless steel	44.5	56.0	13.0	31.0
Titanium	14.0	20.0	—	80.0
Tungsten carbide	28.0	10.0	50.0	40.0
Other	19.5	29.0	14.0	57.0
Total	**100.0**	**43.0**	**17.0**	**40.0**

METAL POWDER SHIPMENTS (in short tons)

Year	Iron powder (P/M parts only)	Copper and copper base (granular)	Aluminum (atomized granular)	Tin powder
1980	115,915	21,125	44,279	1,198
1981	133,722	22,041	39,831	995
1982	110,561	16,361	28,130	980

Source: Metal Powder Industry Federation

COMPACTING PRESSES (now installed)

	Mechanical		Hydraulic	
Size (tons)	% of total plants	Avg/plant	% of total plants	Avg/plant
Under 20	64.7	3.9	23.5	1.9
20-40	38.2	4.5	14.7	4.4
41-80	41.2	3.5	14.7	1.6
81-100	26.5	6.2	23.5	1.2
101-200	23.5	3.4	20.6	1.3
Over 200	20.6	3.1	17.6	1.0
Total	**76.5**	**11.5**	**55.8**	**3.5**

COMPACTING PRESSES (plans to buy by end of 1984)

	Mechanical		Hydraulic	
Size (tons)	% of total plants	Avg/plant	% of total plants	Avg/plant
Under 20	2.9	1.0	5.9	1.0
20-40	5.9	1.0	2.9	1.0
41-80	2.9	1.0	—	—
81-100	5.9	1.5	—	—
101-200	5.9	1.0	—	—
Over 200	8.8	1.3	2.9	1.0
Total	**30.4**	**1.9**	**5.8**	**1.0**

ISOSTATIC PRESSES

Now installed		Plans to buy	
% of total plants	Avg/plant	% of total plants	Avg/plant
23.5	1.5	5.9	1.0

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equipment was fabricated in-house, whereas the remainder was commercially built. The age distribution of the respondents' presses is normally distributed with an average age of 11.2 years. Respondents rate 85% of their equipment in good condition, 14.5% in fair and 0.5% in poor condition. Mechanical presses are by far the most popular type of press among our respondents with 76.5% of the total number of plants having an average of 11.5 presses. 58.8% of the respondents have an average of 3.5 hydraulic presses and 23.5% have an average of 1.5 isostatic presses/plant.

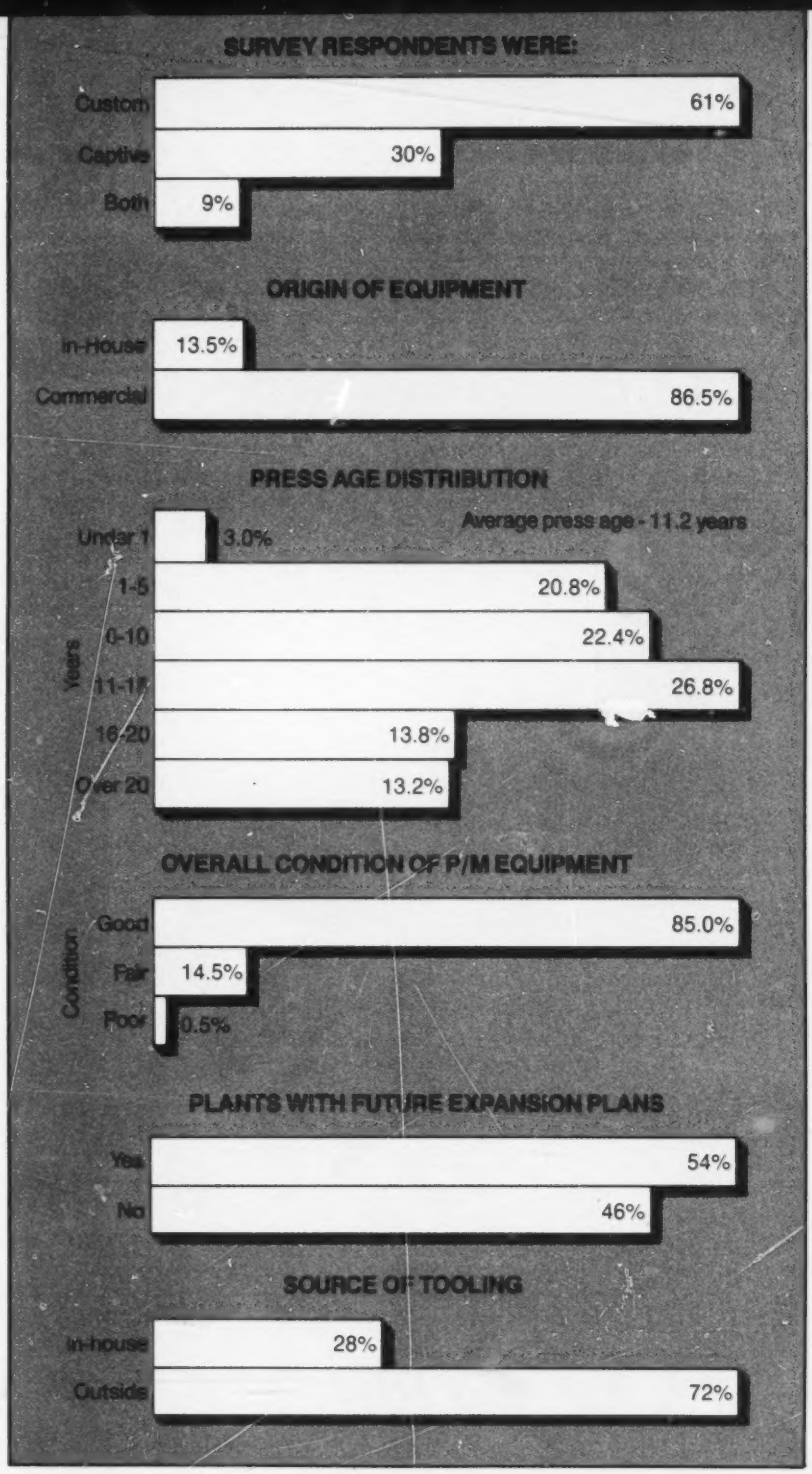
54% of the survey respondents indicate that they have some unspecified future expansion or capital improvement plans. In regard to the acquisition of new presses through 1984, 20.6% of the respondents plan on adding an average of 1.9 mechanical presses to their facilities, for an increase in existing presses of 4.4%; 8.8% of the respondents plan on adding an average of one hydraulic press/plant, for an increase in existing presses of 4.3%; and 5.9% of the respondents plan on adding an average of one isostatic press/facility for an increase in existing presses of 16.7%.

Outside tool and die shops accounted for 72% of our respondents' tooling in 1982, while 28% was produced in-house.

Prototype work is currently being conducted at Dixon Sintaloy to produce a 45° helix gear with a spline I.D. According to Adams, this is a new tooling concept and should be a first in the industry.

Hydraulic presses for compacting have undergone recent improvements. One press builder has applied digital control of the transient shape which eliminates hydraulic shock, a perennial problem in hydraulic press operation. The transient shape (TS curve) represents the opening or closing of a hydraulic valve relative to elapse time. The ability to control different TS curve patterns enhances smooth operation.

Johnson of MPIF expects P/M forging to show good growth and to expand into new markets previously not open to P/M because of mechanical requirements. Injection molding is another area that holds promise for P/M, cites Johnson.



A few of the many patents dealing with P/M technology and of interest to readers include: a new metal powder composition for high-wear resistant parts that is composed of 5% (by weight) basalt powder and the remainder austenite steel powder, assigned to Bleistahl GmbH, West Germany; a method of manufacturing P/M iron parts reinforced by iron oxides for improved performance, assigned to Slovenska akademia vied, Czechoslovakia; a sintered hard metal with a thin surface layer of tungsten carbide resulting in improved properties for cutting tools, assigned to Sumitomo Electric Industries, Ltd., Japan; and a new process to weld P/M parts to ferrous-base materials, assigned to IPM Corp., Columbus, OH.

ROLL FORMING

PM's roll forming and tube making survey covered custom (48%), captive (30%) and combination (22%) shops from one to 1500 employees with 1982 shipments from 2,000 to 150,000,000 lb.

The survey reconfirms the construction/building products industry's position as the largest end user of roll forms, followed by the automotive and furniture/office equipment industries. Other markets for roll forming include appliances, general consumer items and business machines.

Respondents, for the most part, feel business in 1983 will show an improvement over 1982. 67% of the respondents in all metal categories indicate that shipments will surpass those in 1982, while 23% feel 1983 shipments will remain steady, and 10% expect 1983 results to fall below 1982.

The Custom Roll Forming Institute (CRFI) reports an upward trend in business conditions among roll formers. In early 1983, a generally pessimistic mood prevailed. However, by the end of August, CRFI's inventory of business conditions showed that the majority of participants report good business with improvement in sight for the future.

Roll formers report that they are now faced with all the classic problems associated with an upturn in the economy: extended lead times from suppliers and short lead times from customers; cash flow and collection problems; and a shortage of skilled labor.

Sam Marchiando, general sales manager for Dahlstrom Mfg. Co., Jamestown, NJ, feels that value-added is one way for a roll former to increase both market share and total revenue. "We have a number of manufacturing

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TUBE MILL BREAKDOWN

Maximum tube O.D.	% of total plants	Avg/plant
Under 1″	2.5	1.0
1½″	16.5	3.7
2 ⅛″	2.5	1.0
2½″	7.0	6.0
3″	14.5	5.5
5″	7.0	2.0
6″	2.5	1.0
7″	7.0	1.3
Over 7″	14.5	2.5

ROLL FORMERS/TUBE MILLS

	Installed		Plan to buy by end of 1984	
	% of total plants	Avg/plant	% of total plants	Avg/plant
Roll formers	76.5	6.3	31.0	1.4
Tube mills	31.0	7.5	9.5	3.8

ROLL FORMING MACHINE BREAKDOWN

Sets of roll stands	% of total plants	Avg/ plant	Roll shape diameters	% of total plants	Avg/ plant	Maximum strip width	% of total plants	Avg/ plant
2-4	24.0	2.0	1″ & under	30.0	3.5	Under 2″	2.5	1.0
5-8	38.0	3.8	1½″	38.0	5.4	2-6″	40.5	4.2
9-12	40.5	4.1	2″	24.0	5.7	6-10″	33.5	5.3
13-15	21.5	5.9	2½″	14.5	2.2	10-15″	26.0	3.3
16-20	12.0	3.2	3″	14.5	2.0	15-30″	26.0	2.3
21-25	9.5	2.5	3½ - 4″	16.5	1.6	30-50″	16.5	2.7
Over 25	—	—	Over 4″	2.5	2.6	Over 50″	2.5	2.0

SOURCE AND FORM OF RAW MATERIAL

	Source in 1982					
	Mill		Service center		Total	
Form of material	% of total plants	Avg/plant	% of total plants	Avg lb/plant	% of total plants	Avg lb/plant
Coil	74.0	9,336,200	48.0	442,700	87.0	8,179,300
Strip	13.0	8,700	8.5	3,000	17.5	8,000
Sheet	8.5	550,000	13.0	538,300	17.5	678,800
Total	**83.0**	**7,265,500**	**61.0**	**405,700**		

PLANT SIZE BREAKDOWN

Hourly employees/plant

Average	85
Median	8
Low	1
High	1500

1982 Shipments/plant

Average	15,111,000 lb
Low	2,000 lb
High	150,000,000 lb

1983 ROLL FORMING/TUBE MAKING SHIPMENTS BY METAL (compared to 1982)

Metal	% of respondents	% Up	% Down	% Same
Aluminum	33.3	85.0	7.5	7.5
Brass	15.4	50.0	16.5	33.5
Copper	10.3	50.0	—	50.0
Prefinished strip	56.4	77.5	9.0	13.5
Carbon steel	61.5	58.5	12.5	29.0
Galvanized steel	51.3	75.0	—	25.0
Alloy steel	23.1	67.0	11.0	22.0
Stainless steel	33.3	54.0	23.0	23.0
Other	5.1	50.0	—	50.0
Total	**100.0**	**67.0**	**10.0**	**23.0**

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capabilities to complement the roll forming process, and we're experiencing improved business because of it."

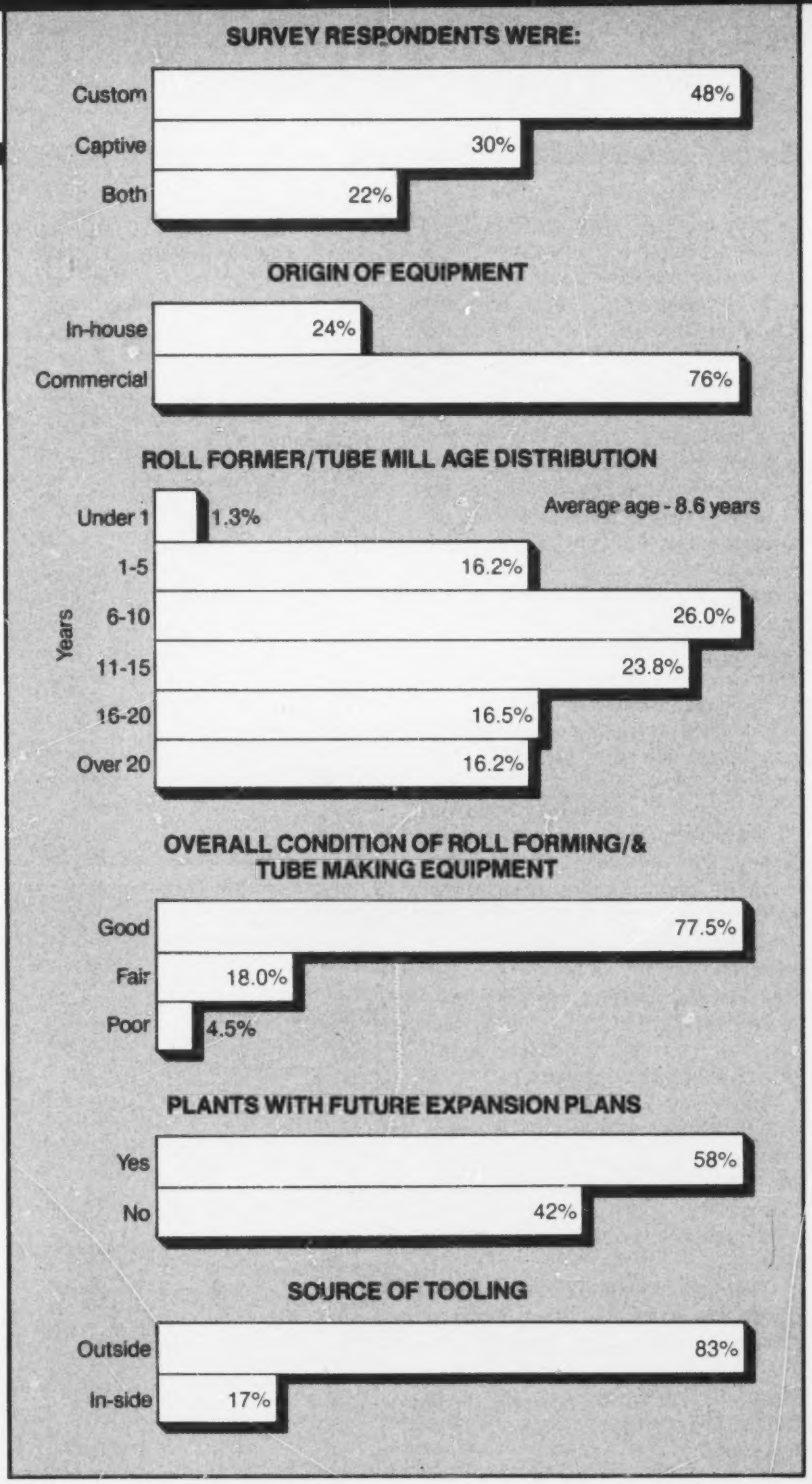
The Welded Steel Tube Institute (WSTI) reports that its members are still faced with depressed conditions. As of the end of August, the WSTI business survey revealed that 72% of its participants' business is in fair or poor condition, with no change in the future outlook. Imports are cited as a major problem impeding a recovery, with Korea noted as the primary source for imports.

"Figures indicate that the recovery may be broadening into some previously depressed sectors, such as capital goods and commercial construction," says Andrew Sharkey, president of the Steel Service Center Institute (SSCI). "While inventory control continues to be tight, we are seeing some inventory replenishing," he says. "But because this is so closely tied to demand, we don't expect to see any dramatic change in the current inventory-to-sales trend."

Respondents report that first time customers and/or jobs in 1982 represented 9% of their business. Of this amount, 24.5% were switch-overs from other processing methods, predominately brake press forming, but also stamping and extrusion. This represents a 2.2% conversion rate for roll forming.

Survey respondents report that commercial sources account for 76% of all in-plant equipment. 77.5% of that in-plant equipment is rated in good condition, 18% is fair and 4.5% is in poor condition. The age distribution of roll forming equipment and tube mills in respondents' facilities is normally distributed with an average age of 8.6 years.

58% of the surveyed roll forming and tube making facilities cite unspecified future expansion plans. 31% of total responding plants plan on acquiring roll forming equipment through 1984 at a rate of 1.4 formers/plant. This rate would increase installed roll forming machines by 8.6%. 9.5% of the responding facilities plan on adding tube mills before the end of 1984 at a rate of 3.8 tube mills/plant, for a total increase in installed tube mills of 15.3%.



Steel mills account for the bulk of material used by our respondents. 83% of the facilities bought an average of 7,265,500 lb. of material in 1982 directly from the mills. Coil is the primary form of raw material used, with 87% of the surveyed plants consuming an average of 8,179,300 lb. of coil stock in 1982.

Outside roll makers accounted for 83% of our respondents tooling in 1982. This is a higher percentage than in previous years and could represent the efficiencies achieved by commercial roll makers. According to Steve Yanochko, vice president of Roll-Kraft, Inc., Willoughby, OH, the NC machine has revolutionized roll making. Before NC machines, all rolls were made by grinding. "The only areas we grind today are small, intricate shapes," Yanochko concludes.

STAMPING

PM's study of stamping producers covered custom (36%), captive (45%) and combined (19%) shops ranging in size from two to 130 employees and 1982 shipments from 8,500 to 48,000,000 lb.

Surveyed stampers report that 12% of their 1982 business included first time customers and/or jobs. Of this amount, 18.6% were switch-overs from other fabricating methods. This results in a 2.2% conversion rate for our respondents in 1982 from such processing methods as casting, extrusion, press brake forming, plastics and machining.

More of our respondents utilized service centers rather than mills in 1982 (72.0% vs. 65.5%), but mills are shipping a larger portion of the material, an average of 7,121,200 lb./plant vs. 5,011,200 lb./plant in 1982. Coil is the most widely used form of metal with 87.5% of the plants consuming an average of 7,391,900 lb. in 1982.

Of the metal stampers surveyed, 53.1% anticipate business in 1983 to be the same as 1982 and 30.1% are expecting an improvement. The 23.3% increase in domestic automotive sales in the first eight months of 1983 over last year has contributed to the improved stamping business.

The American Metal Stamping Association (AMSA) reports a 2% increase in shipments during the first six months of 1983 over the same period in 1982. But perhaps more encouraging is a 17% increase in bookings for the same period.

"The business trend for stampers is definitely up," states Robert Nellemann, vice president, marketing, Diebel Manufacturing Co., Morton Grove, IL. "As a matter of fact, we're forecasting a 30% increase in sales this year."

PM's survey indicates that the automotive industry is still the largest user of stampings followed by the construction/building and furniture/office equipment industries.

With the trend toward product downsizing of the traditional markets, namely automotive, stampers have to diversify toward high technology markets, suggests Carl Smith, chairman of AMSA and president of C. E. Smith Co., Greensboro, NC. "Manufacturers

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PLANT SIZE BREAKDOWN	
Hourly employees/plant	
Average	24 employees
Median	14 employees
Low	2 employees
High	130 employees
1982 shipments/plant	
Average	6,048,761 lb
Low	8,500 lb
High	48,000,000 lb

1983 STAMPING SHIPMENTS BY METAL (compared to 1982)

Metal	% of respondents	% Up	% Down	% Same
Aluminum	64.6	42.0	10.0	48.0
Beryllium copper	37.5	44.5	11.0	44.5
Brass	52.1	16.0	28.0	56.0
Bronze	39.6	16.0	16.0	68.0
Copper	45.8	18.0	14.0	68.0
Nickel	33.3	12.5	12.5	75.0
Alloy steel	52.1	36.0	16.0	48.0
Carbon steel	77.1	49.0	16.0	35.0
Galvanized steel	37.5	33.5	22.0	44.5
Polished steel	29.2	7.0	7.0	86.0
Prefinish steel	29.2	7.0	14.5	78.5
Stainless steel	50.0	46.0	25.0	29.0
Terne plate	20.8	10.0	20.0	70.0
Tin plate	29.2	28.5	21.5	50.0
Other	10.4	60.0	20.0	20.0
Total	**100.0**	**30.0**	**17.0**	**53.0**

MECHANICAL PRESSES

Size (tons)	Now installed		Plan to buy by end of 1984	
	% of total plants	Avg/plant	% of total plants	Avg/plant
Under 10	42.6	4.5	—	—
11-50	87.2	6.7	12.8	1.3
51-100	83.0	5.2	12.8	1.2
101-500	51.1	3.9	14.9	1.6
501-1,000	4.3	1.5	2.1	1.0
Over 1,000	4.3	1.0	—	—
Total	**100.0**	**14.1**	**34.0**	**1.7**

HYDRAULIC PRESSES

Size (tons)	Now installed		Plan to buy by end of 1984	
	% of total plants	Avg/plant	% of total plants	Avg/plant
Under 10	6.4	5.7	—	—
11-50	17.0	4.3	2.1	1.0
51-100	8.5	1.5	—	—
101-500	17.0	1.3	2.1	1.0
501-1,000	4.3	1.0	—	—
Over 1,000	—	—	—	—
Total	**40.4**	**3.8**	**4.3**	**1.0**

MULTI-SLIDE MACHINES

Size (tons)	Now installed		Plan to buy by end of 1984	
	% of total plants	Avg/plant	% of total plants	Avg/plant
1-5	2.1	2.0	—	—
6-10	4.3	1.5	—	—
10-20	8.5	1.3	—	—
Over 20	4.3	9.5	—	—
Total	**12.5**	**4.8**	**—**	**—**

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should look to high tech and electronics applications, where there is a need for small precision stampings for electrical connections and parts," he concludes.

Nellemann agrees, With the Department of Commerce forecasting a growth rate in electronics greater than the general economy, the electronics market is particularly encouraging."

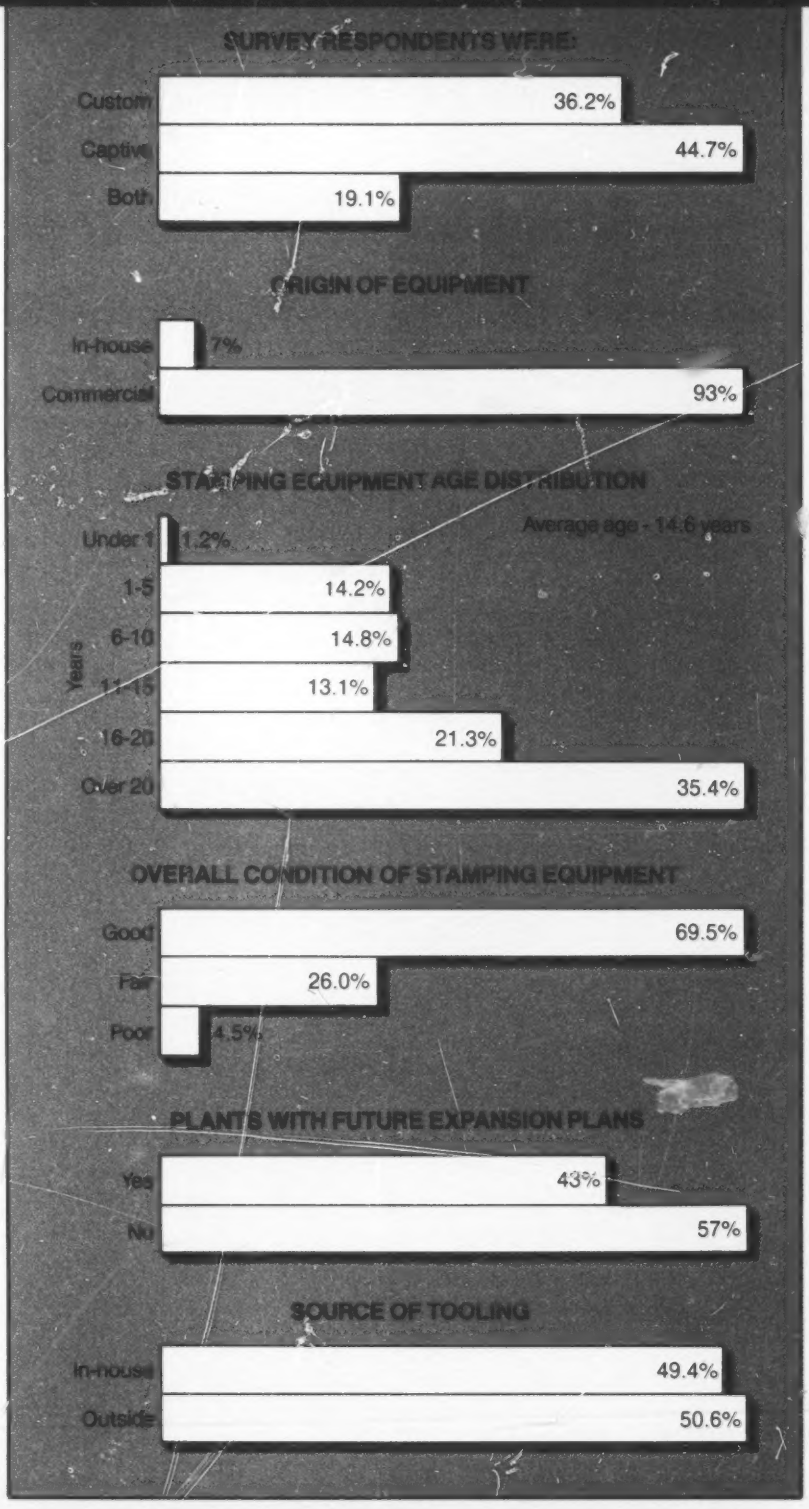
Respondents report that the source of their plant equipment is mainly (93%) commercial machine builders. Forming equipment age distribution is skewed to the high end, with an average age of 14.6 years. Respondents graded 69.5% of their equipment in good condition, 26% fair and 4.5% in poor condition. 43% of our respondents report that they have some unspecified plans for future expansion or capital improvement.

All responding stamping plants utilize mechanical presses, with 34% of them planning to add mechanical presses before the end of 1984 at a rate of 1.7 presses/plant. This activity is centered in three size classifications, 11-50, 51-100 and 101-500 ton capacities. This level of activity would increase the number of existing mechanical presses by 4.1%.

Hydraulic presses play a smaller role among our surveyed stampers. 40.4% of the facilities questioned have hydraulic presses installed at a rate of 3.8 presses/plant, and only 4.3% of the total plan to acquire a hydraulic press before the end of 1984. This represents an increase in installed hydraulic presses of 2.9%.

Only 12.5% of surveyed facilities utilize multi-slide machines, at a rate of 4.8 machines/plant,and there is no indication of new acquisition through 1984.

The source of tooling is almost split equally between in-house (49.4%) and outside (50.6%) tool and die shops. **PM**



SOURCE AND FORM OF RAW MATERIAL

	Source in 1982					
	Mill		Service center		Total	
Form of material	% of total plants	Avg lb/plant	% of total plants	Avg lb/plant	% of total plants	Avg lb/plant
Coil	56.5	5,749,100	56.5	5,749,400	87.5	7,391,500
Strip	25.0	1,091,500	37.5	145,700	53.0	616,500
Sheet	31.5	3,733,000	53.0	589,400	72.0	2,053,700
Total	56.5	7,121,200	75.*	5,011,200		